

C4110 Log Data Report

Borehole Information:

Borehole: C4110		Site: 216-A-10 Crib			
Coordinates (WA State Plane)		GWL (ft)¹: Not reached		GWL Date: 4/10/2003	
North N/A ³	East N/A	Drill Date April 2003	TOC² Elevation N/A	Total Depth (ft) 60	Type Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 7/16	5 7/16	1/2	0	60
The logging engineer measured the casing stored by the driller using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.						

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe. The driller reported that each section of casing is about 10 ft long with flush outside joints.

Logging Equipment Information:

Logging System: Gamma 1D	Type: 35% HPGe (34-TP11019B)
Calibration Date: 09/2002	Calibration Reference: GJO-2002-385-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Logging System: Gamma 2F	Type Moisture (H380932510)
Calibration Date: 10/2002	Calibration Reference: GJO-2002-387-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat			
Date	4/10/03	4/10/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	60.0	56.0			
Finish Depth (ft)	2.0	50.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	n/a ⁴	n/a			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a	n/a			
Pre-Verification	AD056CAB	AD056CAB			

Log Run	1	2/Repeat			
Start File	AD056000	AD056117			
Finish File	AD065116	AD056129			
Post-Verification	AD056CAA	AD056CAA			
Depth Return Error (in.)	0	0			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Neutron-Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat		
Date	4/9/03	4/9/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	60.0	56.0		
Finish Depth (ft)	1.25	46.25		
Count Time (sec)	n/a	n/a		
Live/Real	n/a	n/a		
Shield (Y/N)	N	N		
MSA Interval (ft)	n/a	n/a		
ft/min	1.0	1.0		
Pre-Verification	BF042CAB	BF042CAB		
Start File	BF042000	BF042236		
Finish File	BF042235	BF042275		
Post-Verification	BF042CAA	BF042CAA		
Depth Return Error (in.)	0	0		
Comments	None	Repeat section.		

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe.

SGLS data were collected using Gamma 1D. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K , ^{238}U , and ^{232}Th) verifier with serial number 118.

NMLS logging was performed without a centralizer installed on the sonde. A void space is present around the casing between the ground surface and the 2-ft depth. Data file BF042070 is invalid. The extra counting time for this file is caused by the cable stacking up then rolling over on the return side of the drum.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/15/03	Reference:	GJO-HGLP 1.6.3, Rev. 0
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits. The verification spectra were all within the control limits established on April 10, 2003. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 9.0 percent and 12.0 percent lower at the end of the day.

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The verification spectra were all within the control limits.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. The post-run verification spectrum was used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: g1dsep02.XLS). Zero reference was the ground surface. On the basis of measurements supplied by the driller, the casing configuration was assumed to be one string of 6-in. casing to 60 ft. The casing correction factor was calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. Water corrections were not needed or applied to the data. SGLS dead time corrections were applied when dead time exceeded 10.5 percent.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron moisture calibration is based on a typical 6-in. casing with a thickness of 0.28 in. No casing correction function is available for the neutron log. The effect of the thicker casing may be to underestimate the moisture content.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K , ^{238}U , and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected in the interval from 47.5 ft through 60 ft at concentrations ranging from 0.4 pCi/g to 1,500 pCi/g. The maximum concentration of ^{137}Cs was measured at 57.5 ft. ^{137}Cs was also detected at log depths of 7, 13, and 30 ft with concentrations near the MDL (0.2 pCi/g).

Recognizable changes in the KUT logs occurred in this borehole. The log spectra between 32 to 38 ft display anomalously low count rates. These low KUT concentrations between 32 and 38 ft probably correspond with the rock fill located near the base of the crib. The volume fraction of water is 2 percent or less in this interval as well.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. ^{137}Cs and the natural radionuclides at energy levels of 662, 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The neutron-moisture and its repeat are within the acceptance criteria.

¹ GWL – groundwater level

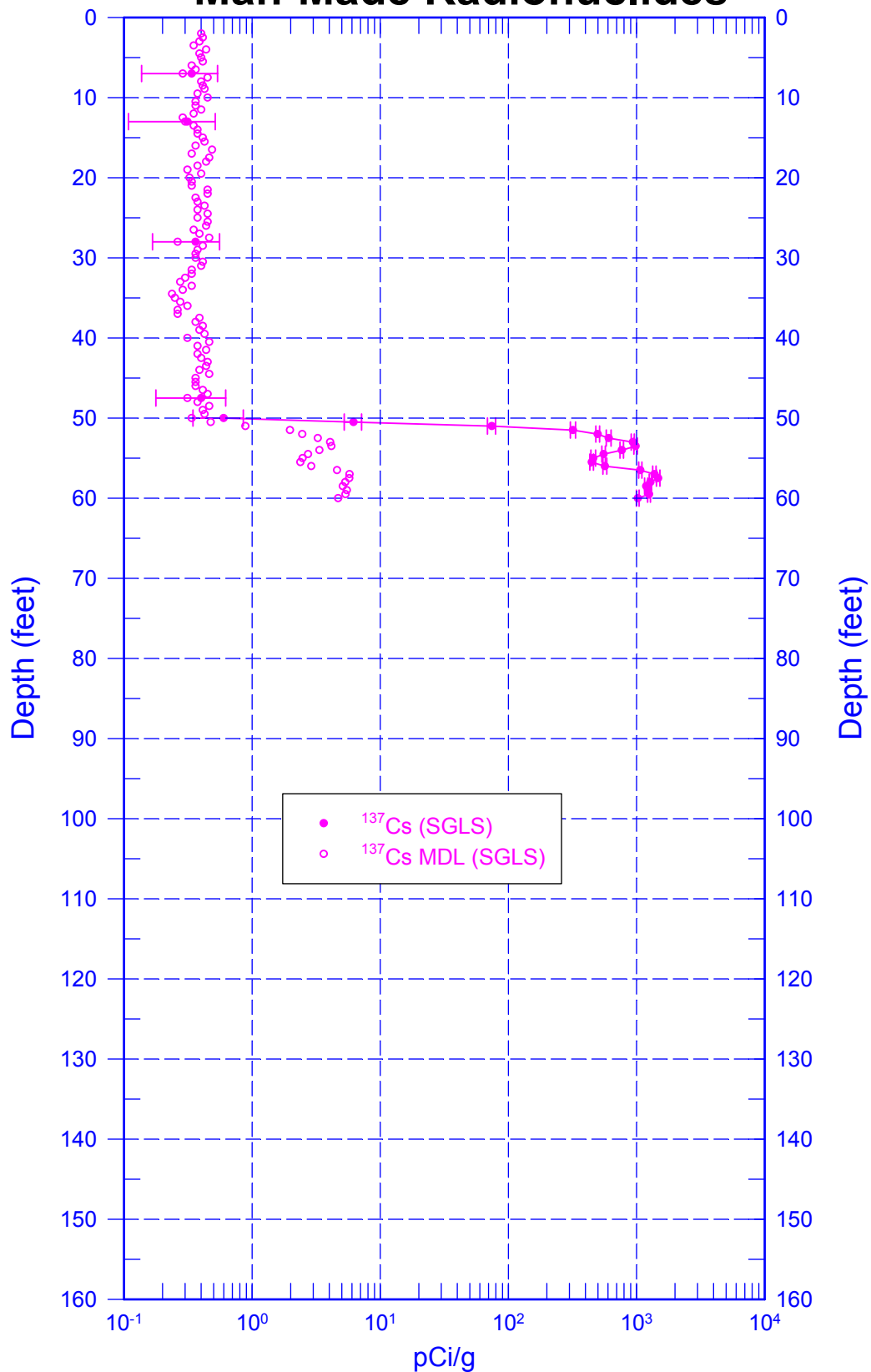
² TOC – top of casing

³ N/A – not available

⁴ n/a – not applicable

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Man-Made Radionuclides

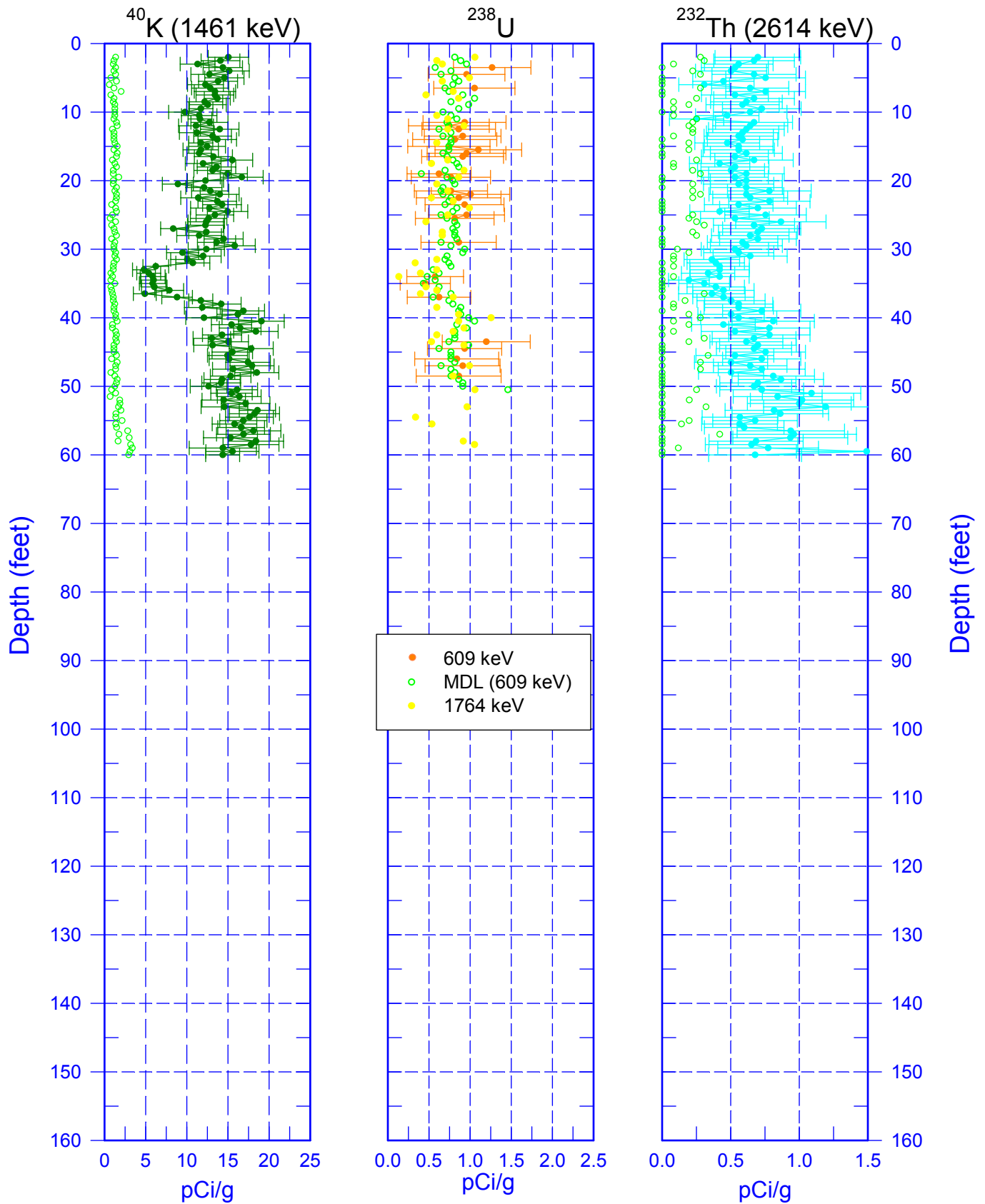


Zero Reference = Ground Surface

Date of Last Logging Run
4/10/2003

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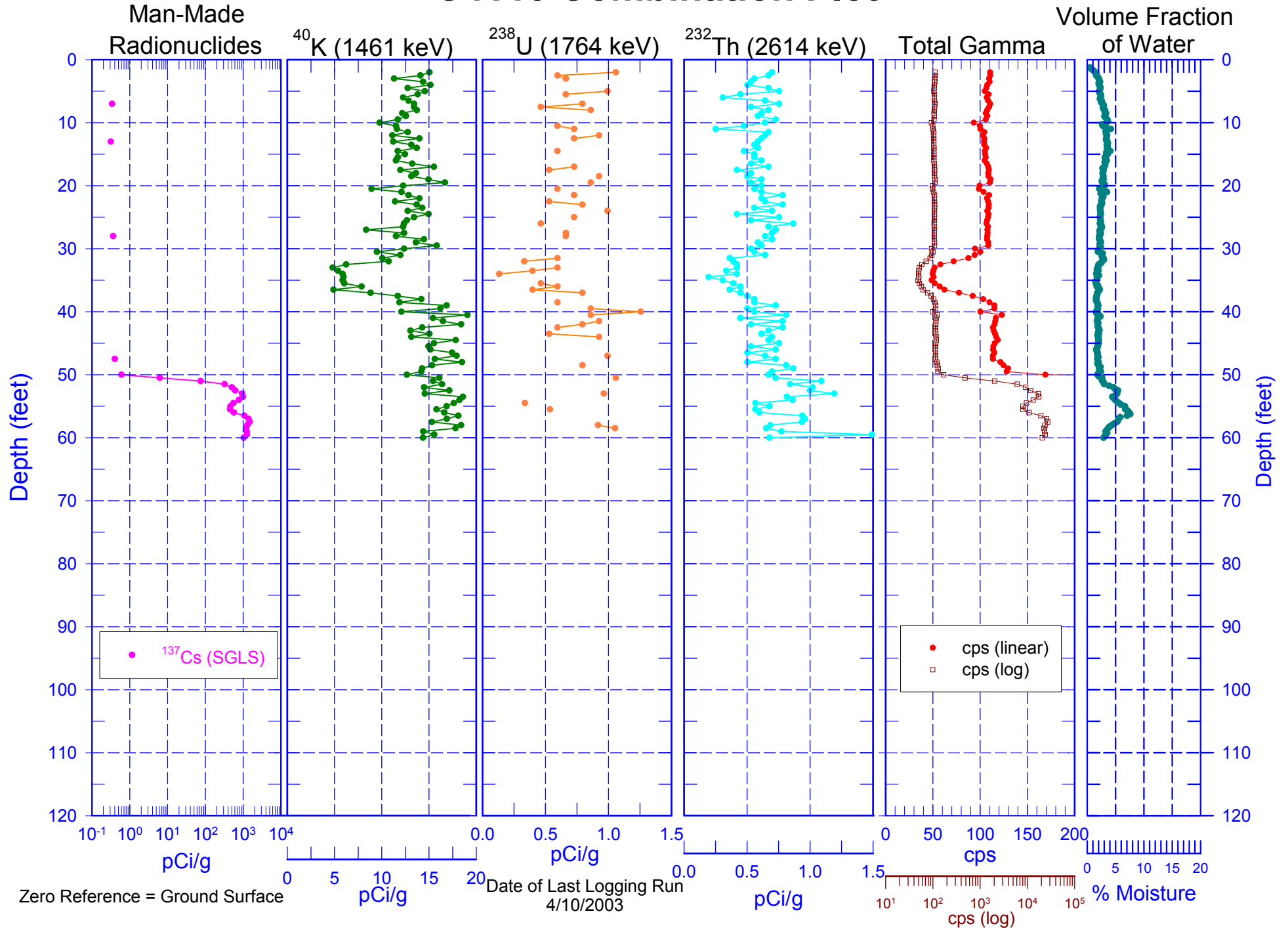
Natural Gamma Logs



Zero Reference = Ground Surface

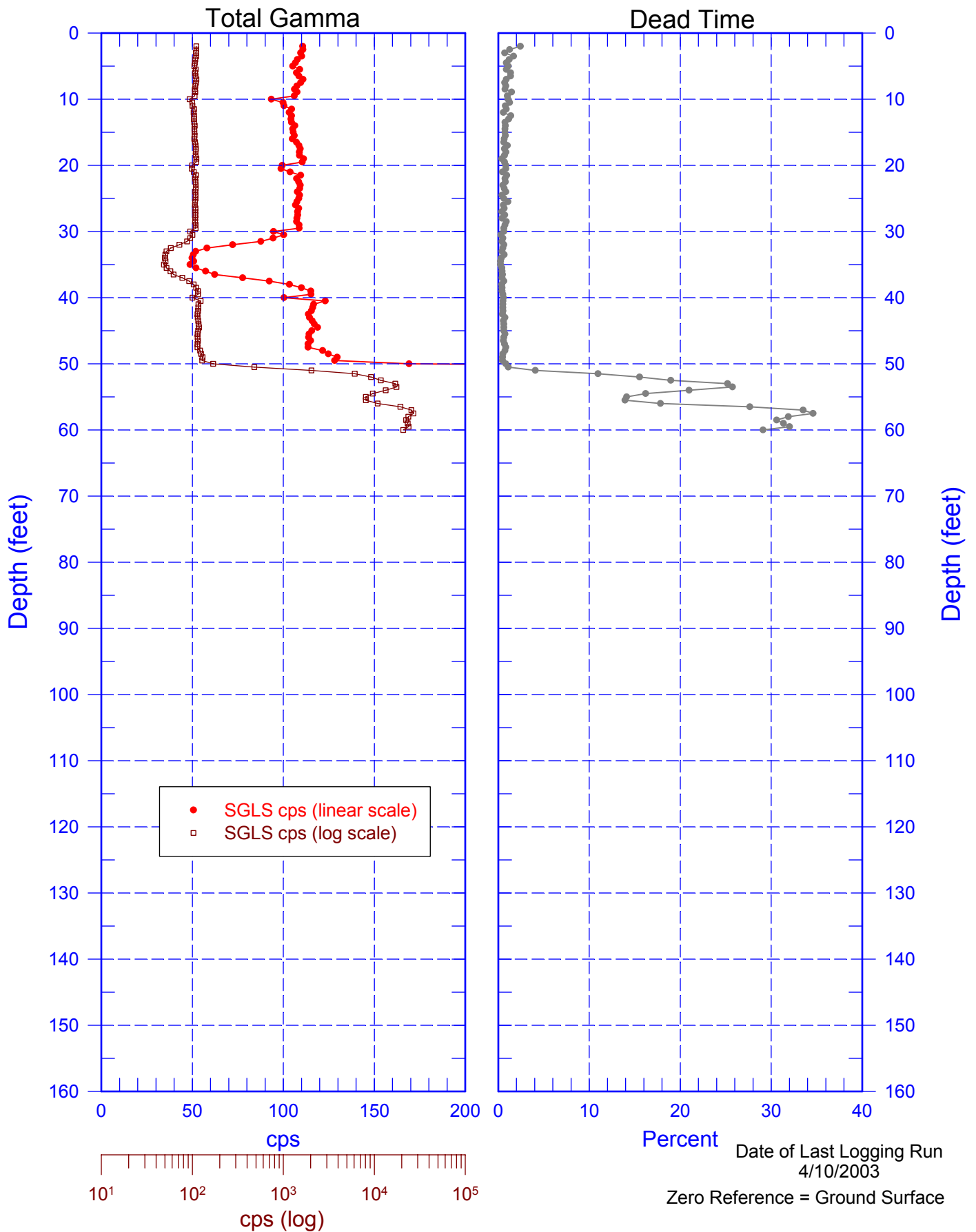
Date of Last Logging Run
4/10/2003

C4110 Combination Plot



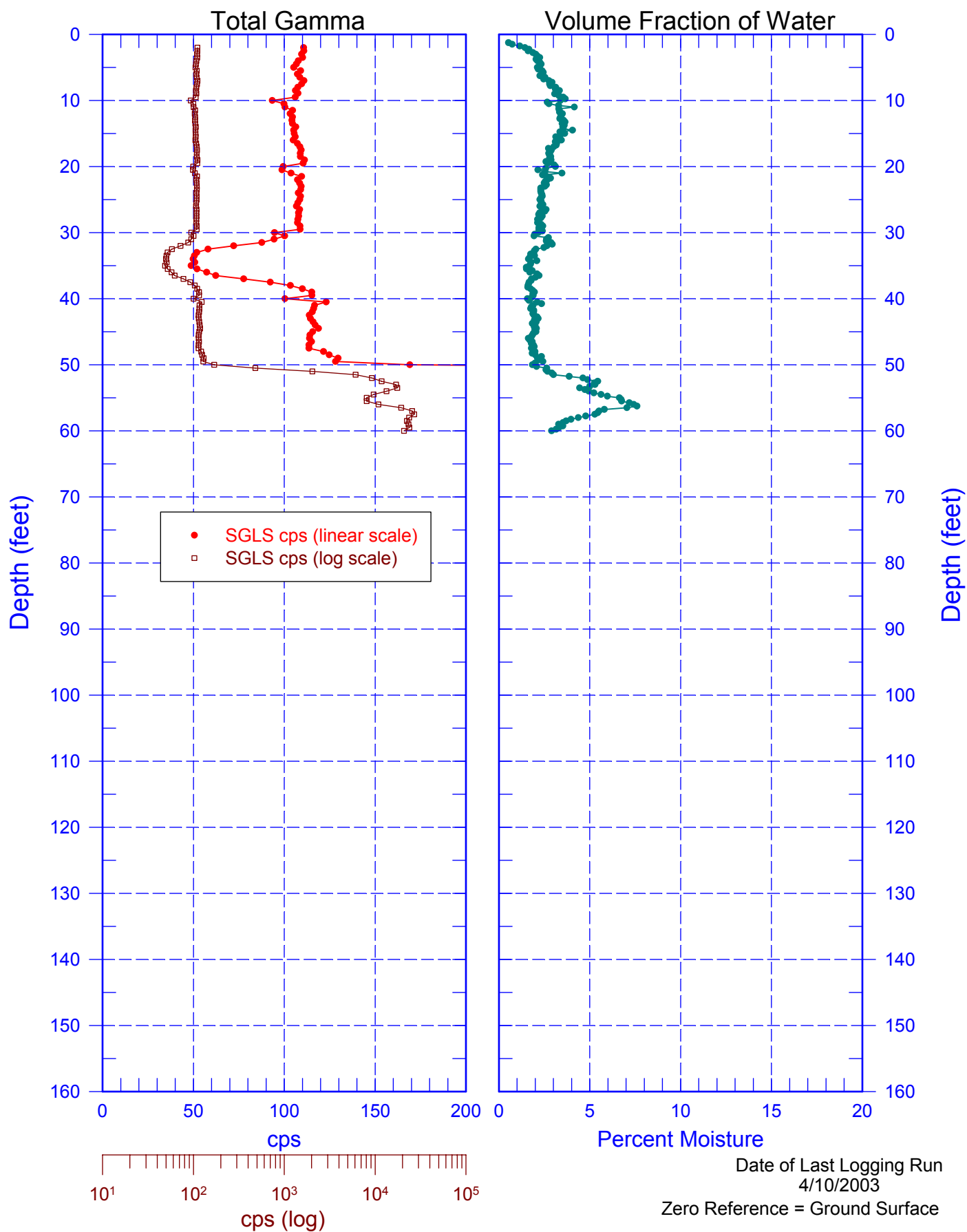
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Total Gamma & Dead Time



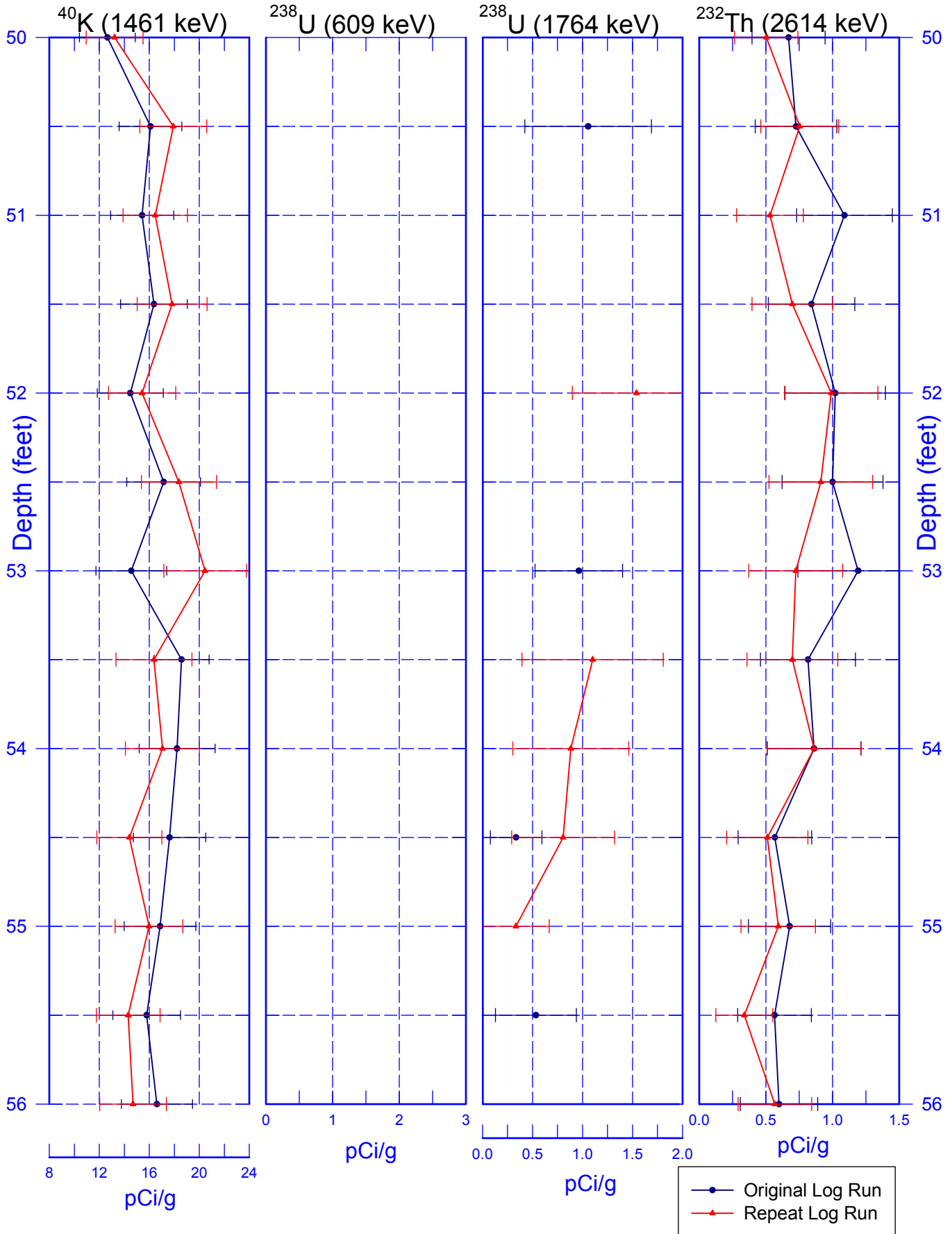
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Total Gamma & Neutron



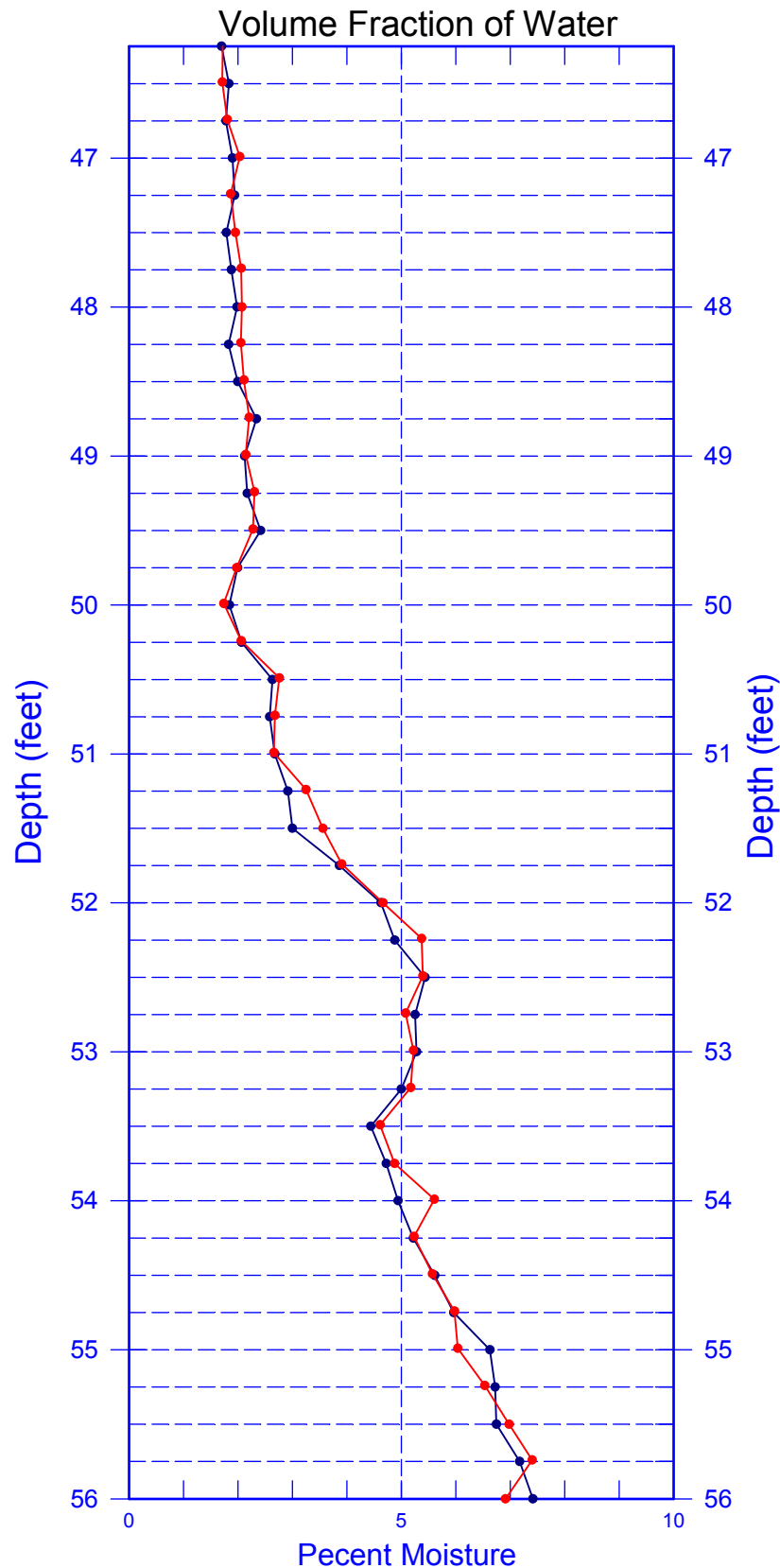
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Rerun of Natural Gamma Logs (56.0 to 50.0 ft)



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Rerun of Neutron-Moisture Log (56.0 to 46.25 ft)



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Rerun of Man-Made Radionuclides

